Non-Contrast MRA Based-on SSFP

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Conventional non-contrast MRA techniques, including time-of-flight (TOF) and phase contrast (PC) methods have not been widely used in clinical practice due to their lengthy acquisition times and potential overestimation of the severity of stenosis due to stagnant or complex flow. However, the TOF phenomenon has become the basis for a variety of MRA techniques that utilize magnetization preparation schemes to suppress venous blood signals as well as background tissue including fat and muscle. Slab-selective inversion-recovery has been used in conjunction with the conventional gradient echo sequence (1) or the steady-state free precession (SSFP) acquisition (2-4) for NC-MRA. While these techniques are potentially useful for ruling out severe disease, they suffer from the inability to accurately define the severity of the disease associated with complex flow patterns due to the inherent limitations of the TOF effect.

Flow-independent angiography (FIA) techniques were proposed to exploits the T1 and T2 differences to isolate arteries from background tissues and veins (5-7). SSFP was used to acquire FIA images due to its high SNR and time efficiency and flow-independent contrast. A potential limitation of this type of methods is that long T2-tissues such as venous blood, fluid, and edema are inadequately suppressed by T2-preparation, interfering with the visualization of arteries, although various techniques have been developed to alleviate this problem.

ECG-triggered fresh-blood imaging (FBI) is a promising non-contrast MRA technique, which uses 3D half-Fourier fast spin-echo for acquiring images at systole and diastole (8,9). Systolic images and diastole images are subtracted to highlight arteries while suppressing venous blood and background signals. The major advantage of the technique is that it doesn't rely on inflow of fresh blood to the imaging volume. Therefore, it can be used for imaging arteries with relatively slow flow such as peripheral arteries.

An alternative approach based on SSFP uses flow-sensitive dephasing (FSD) preparation, which causes signal loss for moving spins due to intravoxel dephasing (10). Subtraction of the dark-artery scan acquired with FSD-preparation during systole and bright-artery scan acquired without FSD-preparation during diastole results in artery-only images.

Most methods developed recently rely on ECG-triggering. A "ghost MRA" method was developed to depict arteries and near total suppression of background signal without the need for cardiac synchronization (11).

Non-contrast methods provide an effective alternative approach for patients with renal impairment.

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